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CITY OF TIFFIN SENECA COUNTY OHIO(U) CORPS OF ENGINEERS
BUFFALO NY BUFFALO DISTRICT   J A KOLLER OCT 84

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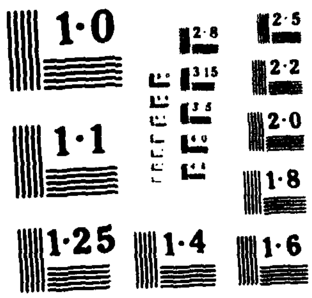
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Special Flood Hazard Evaluation Report

Sandusky River

City of Tiffin
Seneca County
Ohio

Prepared
for the Ohio
Department of Natural Resources

US Army Corps
of Engineers
Buffalo District

October 1984

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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Floodway
Flood Plain Management
Flood Boundaries

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report provides information on the flood plain, floodway, and flood profiles for a selected reach of the Sandusky River within the city of Tiffin, OH, for use in a flood plain management program.

SPECIAL FLOOD HAZARD
EVALUATION REPORT

SANDUSKY RIVER
CITY OF TIFFIN
SENECA COUNTY, OH

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EVALUATION REPORT

SANDUSKY RIVER
CITY OF TIFFIN
SENECA COUNTY, OH

INTRODUCTION

This Special Flood Hazard Evaluation Report, prepared at the request of the Ohio Department of Natural Resources, investigates the potential flood situation along the Sandusky River from the downstream to the upstream corporate limits in the city of Tiffin. Most of the area along the stream in this reach is residential or commercial with some open space. Although large floods have occurred, studies indicate that even larger floods are possible.

Knowledge of potential floods and flood hazards is important in land use planning. This report includes a history of flooding along the Sandusky River and identifies those areas that are subject to possible future floods. Special emphasis is given to those floods through the use of maps and water surface profiles. While the report does not provide solutions to flood problems, it does furnish a suitable basis for the adoption of land use controls to guide flood plain development and thereby prevents intensification of the flood loss problem. It will also aid in the development of other flood damage reduction techniques to modify flooding and reduce flood damages which might be embodied in an overall Flood Plain Management (FPM) program. Other types of studies, such as those of environmental attributes and the current and future land use role of the flood plain as part of its surroundings, would also profit from this information.

Additional copies of this report can be obtained from the Ohio Department of Natural Resources until its supply is exhausted and the National Technical Information Service of the U.S. Dept. of Commerce, Springfield, VA 22161, at the cost of reproducing the report. The Buffalo District Corps of Engineers will provide technical assistance and guidance to planning agencies in the interpretation and use of the data.

PAST FLOODS

People living in the Sandusky River Watershed have suffered from flooding for more than 100 years. Basin-wide floods occurred in February 1833, January 1847, February 1883, January, February and March 1904, March 1913, January 1930, June 1937, January and February 1959, March 1963, March 1978, and June 1981. Damage producing floods occur on the average of about once in every 2 years somewhere along the river.

The greatest flood of record in stage and discharge was the March 1913 flood. More than 20 lives were lost. Damages estimated at the time amounted to well over $2,000,000. A majority of the bridges betweeen Upper Sandusky and the mouth of the river were destroyed. Homes in low-lying areas were flooded to the second floor.

The January and February 1959 floods had considerably less discharge than the March 1913 flood. However, the stages were affected by ice jams. The stages upstream from the Ballville Dam actually exceeded the 1913 flood for about a 4-mile reach because of an ice jam in 1959 and failure of the partially completed dam in the 1913 flood. However, the 1913 flood stages were generally 3 to 7 feet higher in other locations. In Fremont, 700 residences and 225 businesses were affected by the 1959 floods.

Overbank flooding in Tiffin is limited principally to the Mechanicsburg area at the southerly side of the city and to some low-lying areas along the northerly side downstream from the local protection project. Both areas are residential. Because of frequent flooding, the areas have remained only partially developed. The local protection project was built after the disastrous 1913 flood.

Prior to 1913, development seriously encroached on the river channel. The reduced waterway, constrictive bridges and sharp bends combined to cause terrific destruction through the main business and residential districts, during the March 1913 flood. The river was widened, walls constructed, bridges replaced with larger openings and buildings along the banks were removed. Since the project was completed the capacity has not been exceeded. Flood damages in the reach protected by the project have been limited to sewer backup through unprotected outlets.

FUTURE FLOODS

Floods of the same or larger magnitude as those that have occurred in the past are likely to occur in the future. Floods larger than those on the Sandusky River have been experienced in the past on streams with similar geographical and physiographical characteristics as those found in the study area. Similar combinations of rainfall, snowmelt, and runoff which caused these floods could occur within the study area. To assess the flooding potential of the study area, it is necessary to consider storms and floods that have occurred in regions with the same topography, watershed cover, and physical characteristics.

Flood Magnitudes and Their Frequencies

Floods are classified on the basis of their frequency or return period. A 100-year flood is an event whose magnitude can be expected to be exceeded on the average of once every hundred years. The 100-year event has a 1 percent chance of exceedence in any given year. It is important to note that, while on a long-term basis the exceedence averages out to once per hundred years, floods of this magnitude can occur in any given year or even in consecutive years and within any given time interval.

Similarly, the 10, 50, and 500-year flood events are those floods whose magnitudes can, in the long term, be expected to be exceeded on the average of once in every 10, 50, or 500 years.

It should be noted that there is a greater than 50 percent probability that a 100-year flood event will occur during a 70-year lifetime. Additionally, a

house which is built at the 100-year flood level has about a one in four chance of being flooded in a 30-year mortgage life.

A 500-year frequency flood is defined as a flood having an average frequency of exceedence in the order of once in 500 years at a designated location, or a flood having a 0.2 percent chance of exceedence in any given year. A flood of this magnitude can be catastrophic, especially when it occurs in developed stream valleys.

Peak discharge-frequency relationships for various floods were determined at several locations along the Sandusky River. Table 1 is a summary of peak discharges for three recurrence intervals (in years).

Table 1 - Peak Flows on the Sandusky River

Location	Drainage Area (sq. mi.)	10-Year Discharge (cfs)	100-Year Discharge (cfs)	500-Year Discharge (cfs)
Northern Study Limit, Downstream from Morrison Crk Confluence	1,028	20,500	33,000	42,500
Upstream from Rock Creek Confluence	966	19,500	31,500	40,500

Hazards and Damages of Large Floods

The extent of damage caused by any flood depends on the topography of the flooded area, the depth and duration of flooding, the velocity of flow, the rate of rise in water surface elevation, and development of the flood plain. Deep water flowing at a high velocity and carrying floating debris would create conditions hazardous to persons and vehicles which attempt to cross the flood plain. Generally, water 3 or more feet deep which flows at a velocity of 3 or more feet per second could easily sweep an adult off his feet and create definite danger of injury or drowning. Rapidly rising and swiftly flowing floodwater may trap persons in homes that are ultimately destroyed or in vehicles that are ultimately submerged or floated. Since waterlines can be ruptured by deposits of debris and by the force of flood waters, there is the possibility of contaminated domestic water supplies. Damaged sanitary sewer lines and sewage treatment plants could result in the pollution by floodwaters and could create health hazards. Isolation of areas by floodwater could create hazards in terms of medical, fire, or law enforcement emergencies.

Flood Profiles and Flooded Areas

Analyses of the hydraulic characteristics of the Sandusky River were carried out to provide estimates of the elevations of the floods of the selected recurrence intervals. Cross-sectional data for the river channel were obtained by field survey. Bridges were surveyed to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Plates 1-2). Selected cross-section locations are also shown on the Flooded Area Maps (Plates 3-10).

The flood profiles were generated using the HEC-2 backwater program (Reference 1). Flood profiles were drawn showing computed water surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. The 10,100, and 500-year floods are shown on the profiles.

The hydraulic analyses for this study are based only on the effects of unobstructed flow. The flood elevations as shown on the profiles are, therefore, considered valid only if the bridges across the Sandusky River remain unobstructed from debris or ice and if channel and overbank conditions remain essentially the same as ascertained during this study.

The areas that would be inundated by the 100-year and 500-year floods are shown on the Flooded Area Maps. The actual limits of these overflow areas may vary somewhat from those shown on the maps because the scale of the maps does not permit precise plotting of the boundaries of the flooded area.

All elevations are referenced from National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in the study are shown in Table 2.

Obstructions

During floods, debris collecting on bridges could decrease their flow-carrying capacity and cause greater water depths (backwater effect) upstream of these structures. Since the occurrence and amount of debris are indeterminate factors, only the physical characteristics of the structures were considered in preparing the profiles. No reduction in the carrying capacity from clogging or jamming was considered. Similarly, maps of the flooded area show the backwater effect of constructed bridge openings, but do not reflect increased water surface elevations that could be caused by debris or ice collecting against the structures.

UNIFIED FLOOD PLAIN MANAGEMENT

Historically, the alleviation of flood damage has been accomplished almost exclusively by the construction of protective works such as reservoirs, channel improvements, and floodwalls and levees. However, in spite of the billions of dollars that have already been spent for construction of well-designed and efficient flood control works, annual flood damages continue to increase because the number of persons and structures occupying floodprone lands is increasing faster than protective works can be provided.

Table 2 - Elevation Reference Marks in the Study Area (1)

Reference Mark	Elevation (NGVD)	Description of Location
RM1	733.75	Huss St. Bridge, over Sandusky River, chiseled square on sidewalk, located east end of bridge, downstream side, near end of concrete sidewalk railing.
RM2	729.02	City of Tiffin BM, point of open/close direction arrow on city hydrant, located on NW cor. of E. Davis St. & Hayward St.
RM3	751.36	Coast-Geodetic Survey Monument Disk, stamped "C 173-1954," located at B&O Railroad station, at the crossing of the B&O RR and Monroe St., set vertically in the south face of concrete foundation of station 48.5 feet south of south rail of main track, 15 feet east of east curb of N. Monroe St., about 1.5 feet above ground.
RM4	737.69	City of Tiffin BM, point of open/close arrow on city hydrant, located on the north side of Riverside Ave., west of the intersection of Riverside Ave., and Jefferson St.
RM5	743.50	City of Tiffin BM, point of open/close arrow on city hydrant, located on west side of Frost Parkway at the intersection of Frost Parkway, Perry St., and Clay St.
RM6	740.60	"P-K" nail in Ohio Bell pole, located at deadend of St. Clair St., north side of pole, ± 2 feet above ground.
RM7	745.89	Chiseled "X", in city hydrant, located on south bonnet bolt, NW corner of Ella St. - Martha St.

(1) Approximate location of the elevation reference marks are shown on the flooded area maps.

Recognition of this trend in recent years has forced a reassessment of the flood control concept and resulted in the broadened concept of unified flood plain management programs. Legislative and administrative policies frequently cite two approaches: structural and nonstructural, for adjusting to the flood hazard. In this context, "structural" is usually intended to mean adjustments that modify the behavior of floodwaters through the use of measures such as public works dams and channel work. "Nonstructural" is usually intended to include all other adjustments in the way society acts when occupying or modifying a flood plain (e.g., regulations, floodproofing, insurance, etc.). Both structural and nonstructural tools are used for achieving desired future flood plain conditions. There are three basic strategies which may be applied individually or in combination: (1) modifying the susceptibility to flood damage and disruption, (2) modifying the floods themselves, and (3) modifying (reducing) the adverse impacts of floods on the individual and the community.

Modify Susceptibility to Flood Damage and Disruption

The strategy to modify susceptibility to flood damage and disruption consists of actions to avoid dangerous, economically undesirable, or unwise use of the flood plain. Responsibility for implementing such actions rests largely with the non-Federal sector and primarily at the local level of Government.

These actions include restrictions in the mode and the time of occupancy; in the ways and means of access; in the pattern, density, and elevation of structures and in the character of their materials (structural strength, absorptiveness, solubility, corrodibility); in the shape and type of buildings and in their contents; and in the appurtenant facilities and landscaping of the grounds. The strategy may also necessitate changes in the interdependencies between flood plains and surrounding areas not subject to flooding, especially interdependencies regarding utilities and commerce. Implementing mechanisms for these actions include land use regulations, development and redevelopment policies, floodproofing, disaster preparedness and response plans, and flood forecasting and warning systems. Different tools may be more suitable for developed or underdeveloped flood plains or to urban or rural areas. The information contained in this report is particularly useful for the preparation of flood plain regulations.

a. Flood Plain Regulations.

Flood plain regulations apply to the full range of ordinances and other means designed to control land use and construction within floodprone areas. The term encompasses zoning ordinances, subdivision regulations, building and housing codes, encroachment line statutes, open area regulations, and other similar methods of management which affect the use and development of floodprone areas.

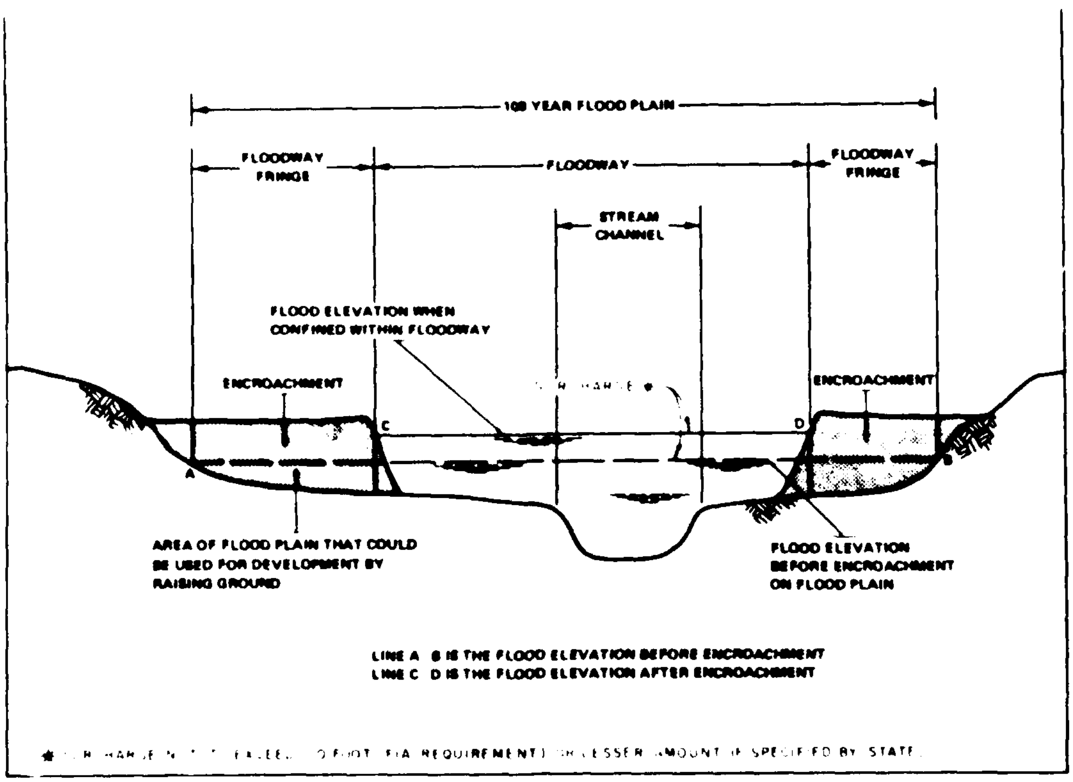
Flood plain land use management does not prohibit use of floodprone areas; to the contrary, flood plain land use management seeks the best use of flood plain lands. The flooded area maps and the water surface profiles contained in this report can be used to guide development in the flood plain. The elevations shown on the profiles should be used to determine flood heights

because they are more accurate than the outlines of flooded areas. Development in areas susceptible to frequent flooding should consist of construction which has a low damage potential such as parking areas and golf courses. If high value construction such as buildings are considered for areas subject to frequent flooding, the land should be elevated to minimize damages. If it is uneconomical to elevate the land in these areas, means of floodproofing the structures should be given careful consideration.

b. Development Zones.

A flood plain consists of two useful zones. The first zone is the designated "floodway" or that cross sectional area required for carrying or discharging the anticipated flood waters with a maximum 1-foot increase in flood level. Velocities are the greatest and most damaging in the floodway. Regulations essentially maintain the flow-conveying capability of the floodway to minimize inundation of additional adjacent areas. Uses which are acceptable for floodways include parks, parking areas, open spaces, etc.

The second zone of the flood plain is termed the "floodway fringe" or restrictive zone, in which inundation might occur but where depths and velocities are generally low. Such areas can be developed provided structures are placed high enough or floodproofed to be reasonably free from flood damage during the Base (100-year) Flood. Typical relationships between the floodway and floodway fringe are shown in Figure 1.



FLOODWAY SCHEMATIC FIGURE

Formulation of Flood Plain Regulations

Formulation of flood plain regulations in a simplified sense involves selecting the type and degree of control to be exercised for each specific flood plain. In principal, the form of the regulations is not as important as a maintained adequacy of control. The degree of control normally varies with the flood hazard as measured by depth of inundation, velocity of flow, frequency of flooding, and the need for available land. Considerable planning and research is required for the proper formulation of flood plain regulations. Where formulation of flood plain regulations is envisioned to require a lengthy period of time during which development is likely to occur, temporary regulations should be adopted to be amended later as necessary.

Modify Flooding

The traditional strategy of modifying floods through the construction of dams, dikes, levees, and floodwalls, channel alterations, high flow diversions and spillways, and land treatment measures has repeatedly demonstrated its effectiveness for protecting property and saving lives, and it will continue to be a strategy of flood plain management. However, in the future, reliance solely upon a flood modification strategy is neither possible nor desirable. Although the large capital investment required by flood modifying tools has been provided largely by the Federal Government, sufficient funds from Federal sources have not been, and are not likely to be available to meet all situations for which flood modifying measures would be both effective and economically feasible. Another consideration is that the cost of maintaining and operating flood control structures fall upon local governments except for major Federal reservoirs with flood control storage.

Flood modifications acting alone leave a residual flood loss potential and can also create an unwarranted sense of security leading to inappropriate use of lands in the areas that are directly protected or in adjacent areas. For this reason, measures to modify possible floods should usually be accompanied by measures to modify the susceptibility to flood damage, particularly by land use regulations.

Flood modifying tools permit changes in the volume of runoff, in the peak stage of the flood, in the time of rise and duration, in the extent of the area flooded, in the velocity and depth of floodwaters, and consequently in the amount of debris, sediment, and pollutants that floods carry.

Modify the Impact of Flooding on Individuals and the Community

A third strategy for mitigating flood losses consists of actions designed to assist individuals and communities in their preparatory, survival, and recovery responses to floods. Tools include information dissemination and education, arrangements for spreading the costs of the loss over time, and purposeful transfer of some of the individual's loss to the community by reducing taxes on flood prone areas.

The distinction between a resonable and unreasonable transfer of costs from the individual to the community can also be regulated and is a key to effective flood plain management.

CONCLUSION

This report presents local flood hazard information for the Sandusky River in the city of Tiffin. The U.S. Army Corps of Engineers, Buffalo District, will provide interpretation and limited technical assistance in the application of the data contained in this report, particularly as to its use in developing effective flood plain regulations. Requests should be coordinated through the Ohio Department of Natural Resources.

GLOSSARY

BACKWATER — The resulting high water surface in a given stream due to a downstream obstruction or high stages in an intersecting stream.

BASE FLOOD — A flood which has an average return interval in the order of once in 100 years, although the flood may occur in any year. It is based on statistical analysis of streamflow records available for the watershed and analysis of rainfall and runoff characteristics in the general region of the watershed. It is commonly referred to as the "100-year flood."

DISCHARGE — The quantity of flow in a stream at any given time, usually measured in cubic feet per second (cfs).

FLOOD — An overflow of lands not normally covered by water. Floods have two essential characteristics: The inundation of land is temporary and the lands are adjacent to and inundated by overflow from a river, stream, ocean, lake, or other body of standing water.

Normally a "flood" is considered as any temporary rise in streamflow or stage, but not the ponding of surface water that results in significant adverse effects in the vicinity. Adverse effects may include damages from overflow of land areas, temporary backwater effects in sewers and local drainage channels, creation of unsanitary conditions or other unfavorable situations by deposition of materials in stream channels during flood recessions, and rise of groundwater coincident with increased streamflow.

FLOOD CREST — The maximum stage or elevation reached by floodwaters at a given location.

FLOOD FREQUENCY — A statistical expression of the percent chance of exceeding a discharge of a given magnitude in any given year. For example, a <u>100-year flood</u> has a magnitude expected to be exceeded on the average of once every hundred years. Such a <u>flood</u> has a 1 percent chance of being exceeded in any given year. Often used interchangeably with <u>RECURRENCE INTERVAL</u>.

FLOOD PLAIN — The areas adjoining a river, stream, watercourse, ocean, lake, or other body of standing water that have been or may be covered by floodwater.

FLOOD PROFILE	A graph showing the relationship of water surface elevation to location; the latter generally expressed as distance upstream from mouth for a stream of water that flows in an open channel. It is generally drawn to show surface elevation for the crest of a specific flood, but may be prepared for conditions at a given time or stage.
FLOOD STAGE	The stage or elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area in which the elevation is measured.
FLOODWAY	The channel of a watercourse and those portions of the adjoining flood plain required to provide for the passage of the selected flood (normally the 100-year flood) with an insignificant increase in the flood levels above that of natural conditions. As used in the National Flood Insurance Program, floodways must be large enough to pass the 100-year flood without causing an increase in elevation of more than a specified amount (1 foot in most areas).
RECURRENCE INTERVAL	A statistical expression of the average time between floods exceeding a given magnitude (see FLOOD FREQUENCY).

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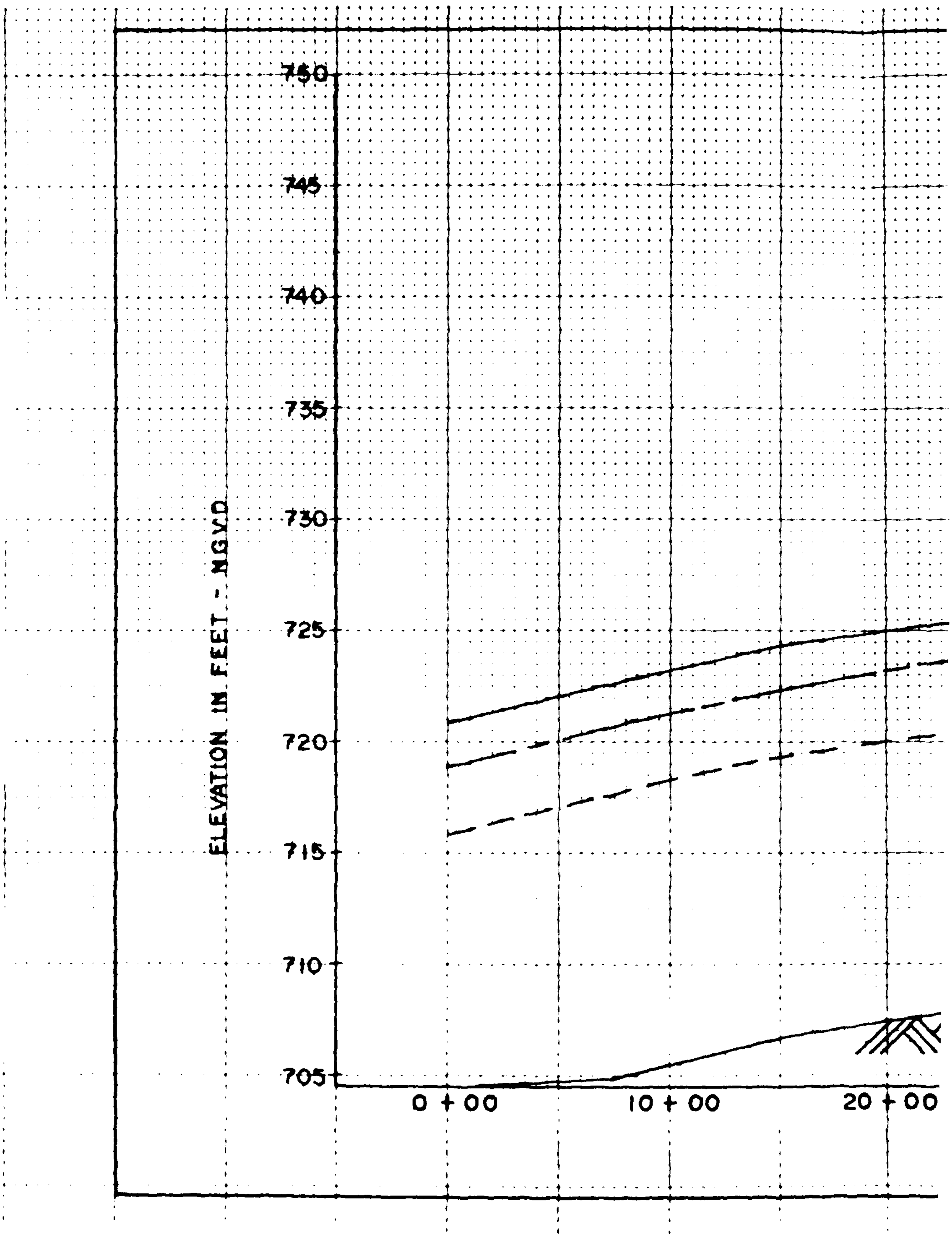

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735
730
725
720
715
710
705
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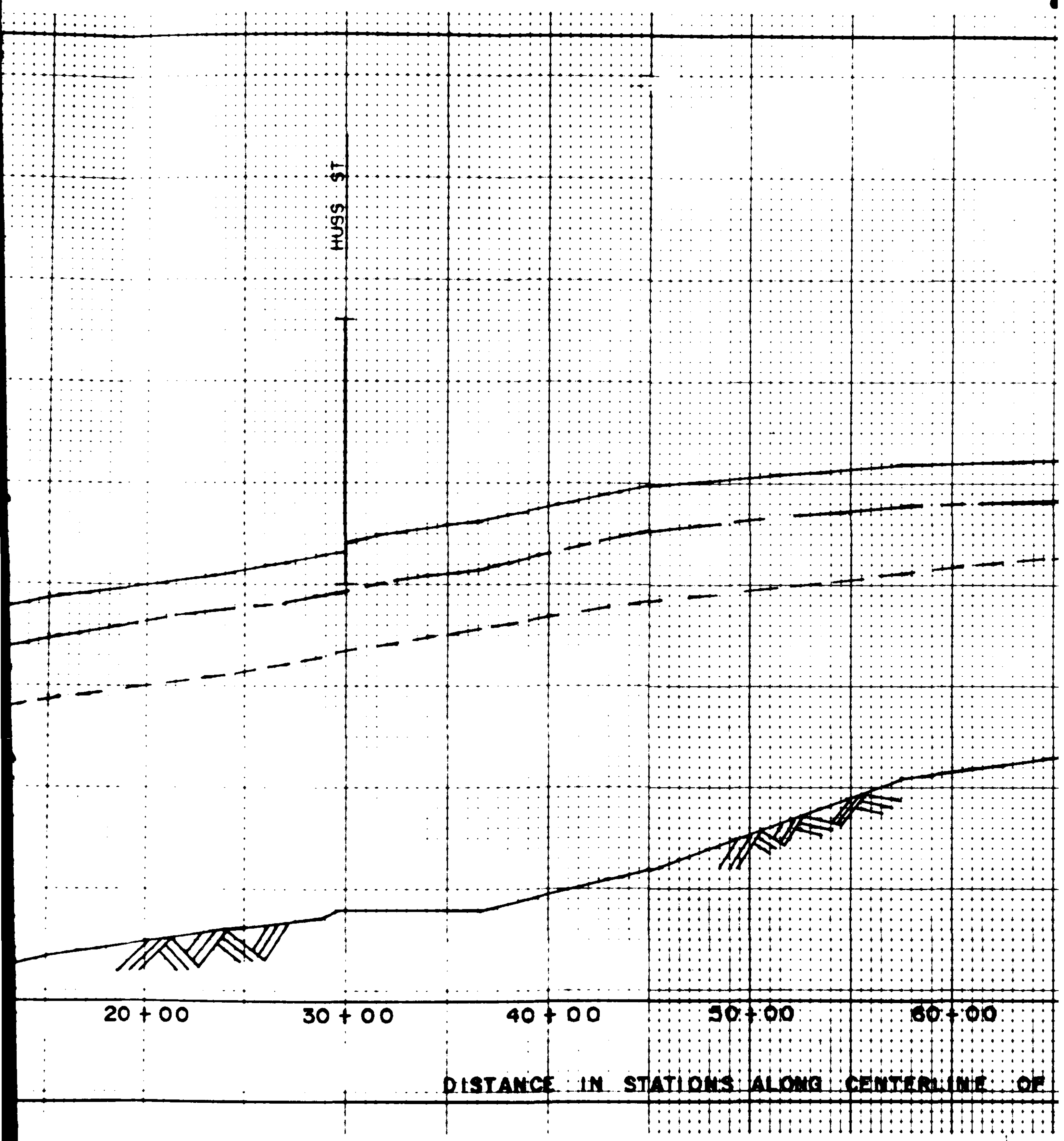
10 + 00
20 + 00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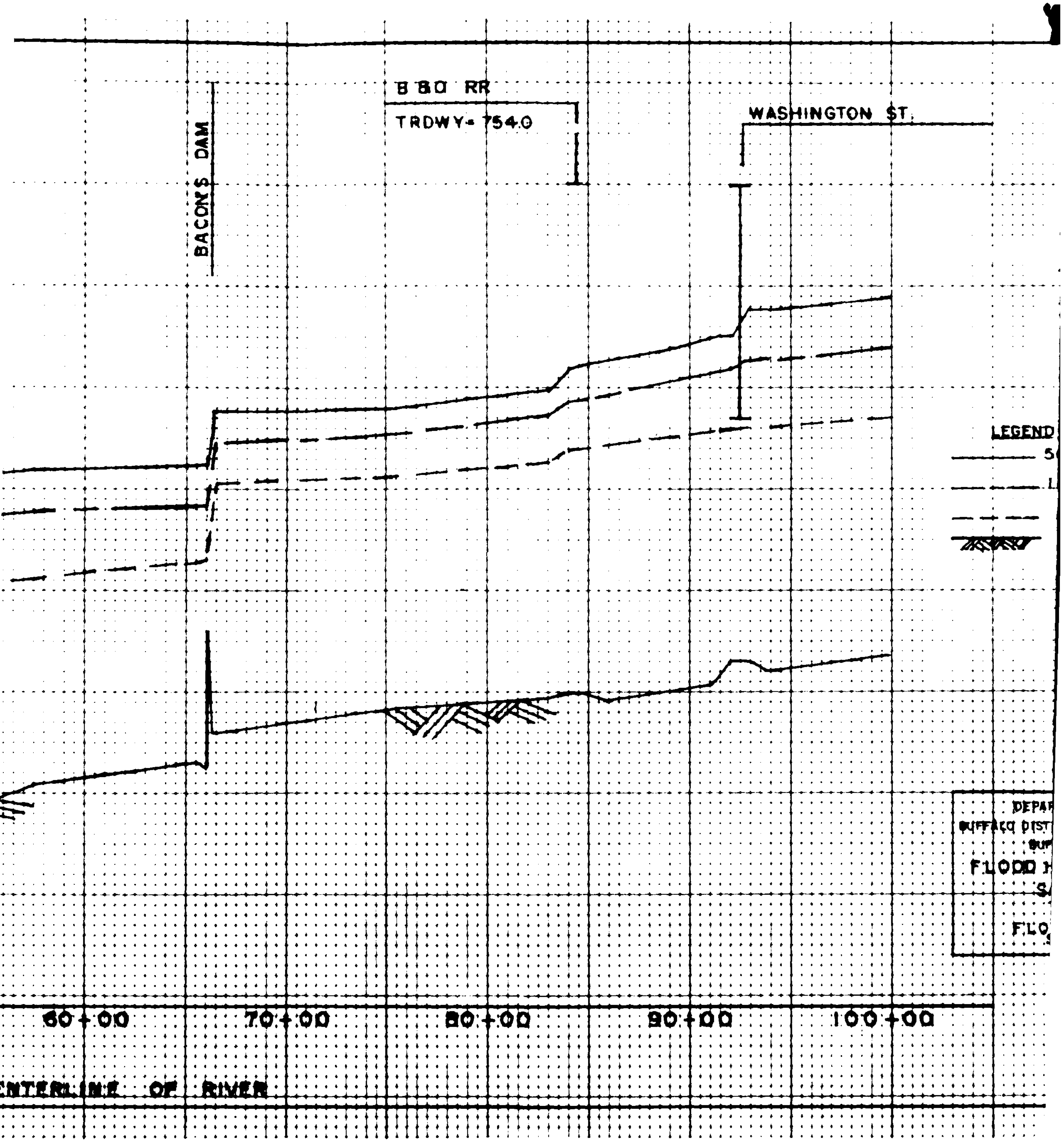
DISTANCE IN STATIONS ALONG CENTERLINE OF



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BACON'S DAM
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FLOOD
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80+00
90+00
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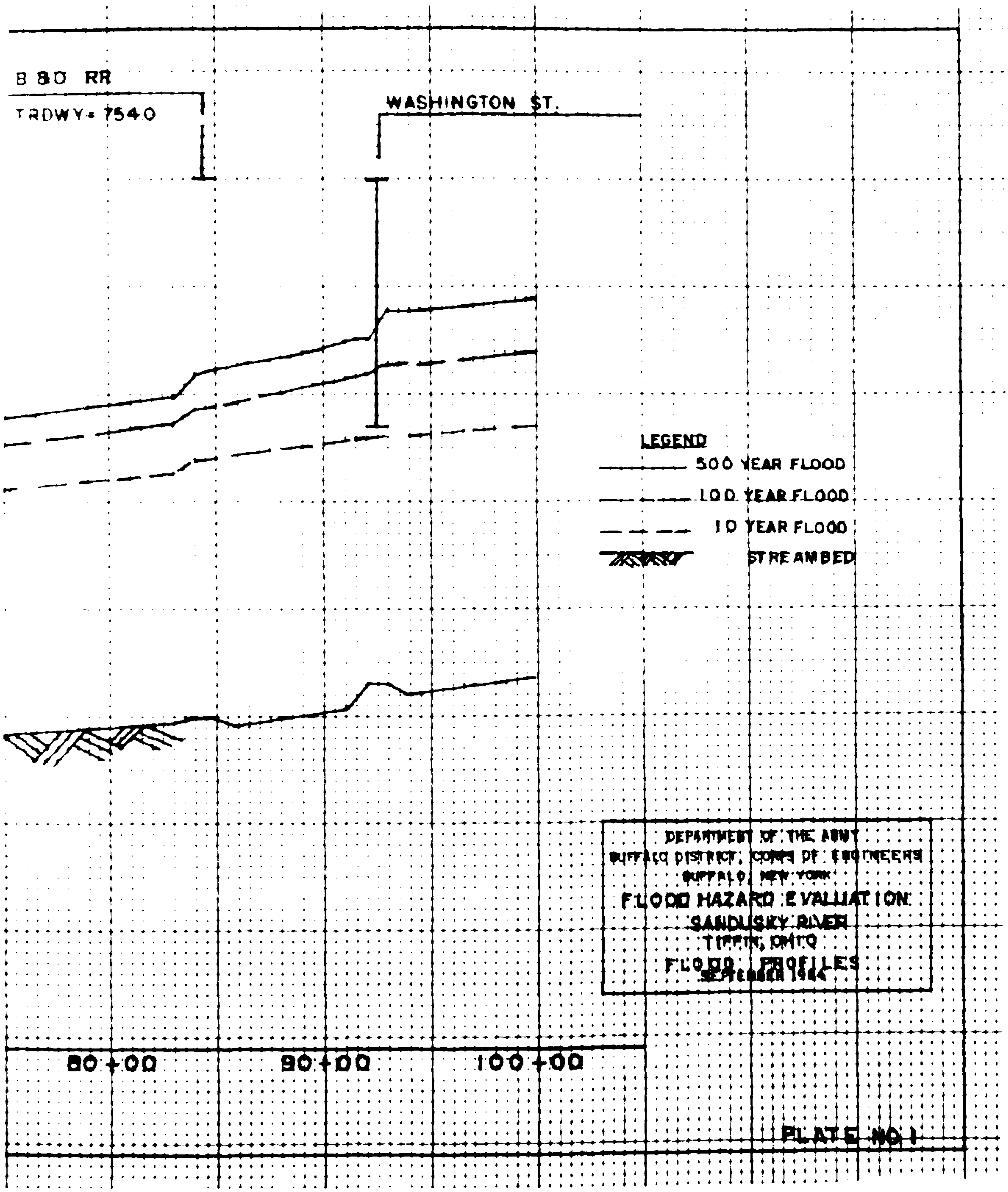
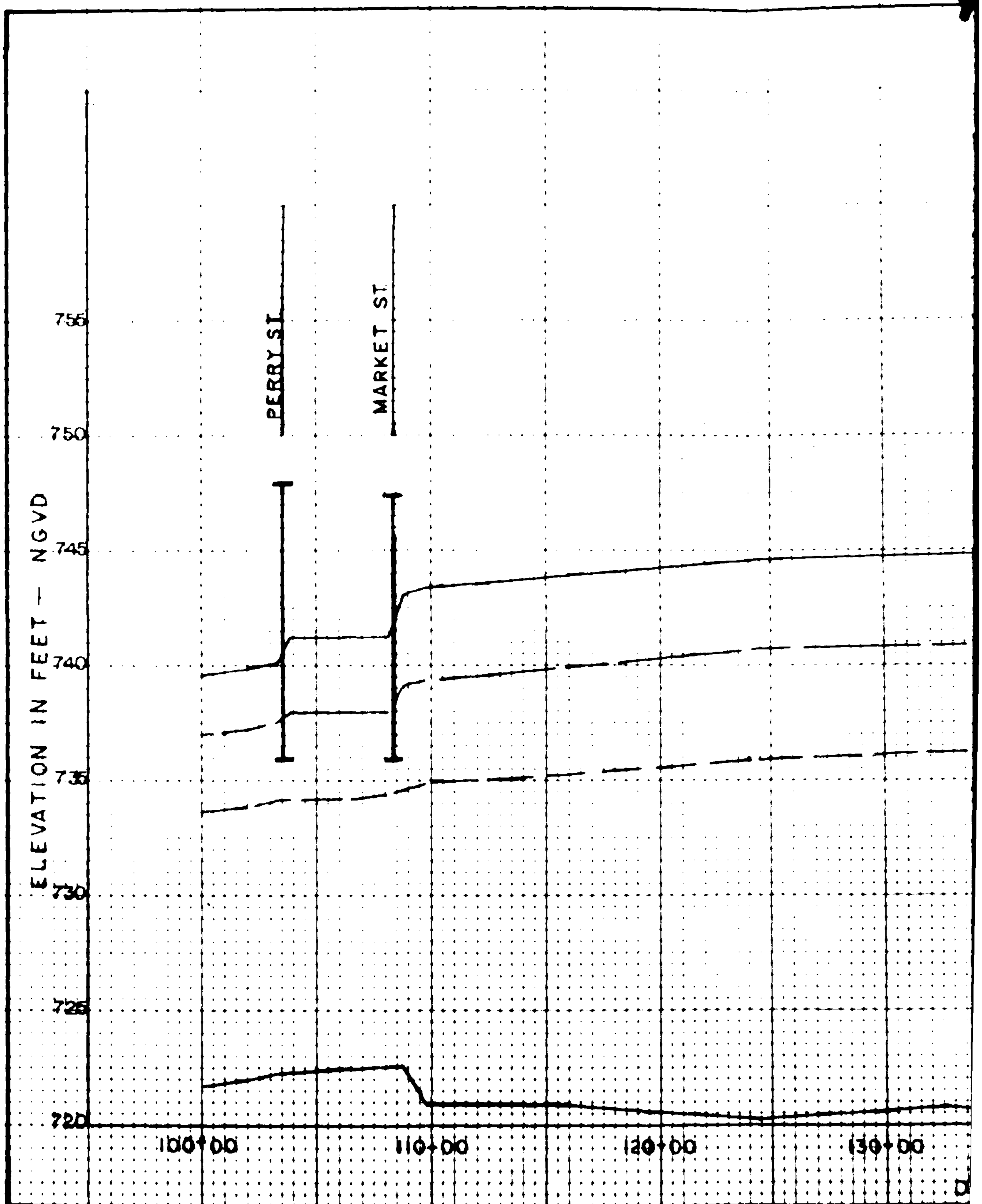
CENTERLINE OF RIVER


B & O RR
TRDWY= 754.0
WASHINGTON ST.
LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
10 YEAR FLOOD
STREAMBED
DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
BUFFALO, NEW YORK
FLOOD HAZARD EVALUATION
SANDUSKY RIVER
TIFFIN, OHIO
FLOOD PROFILES
80+00
90+00
100+00
PLATE NO. 1



ELEVATION IN FEET — NGVD
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MARKET ST
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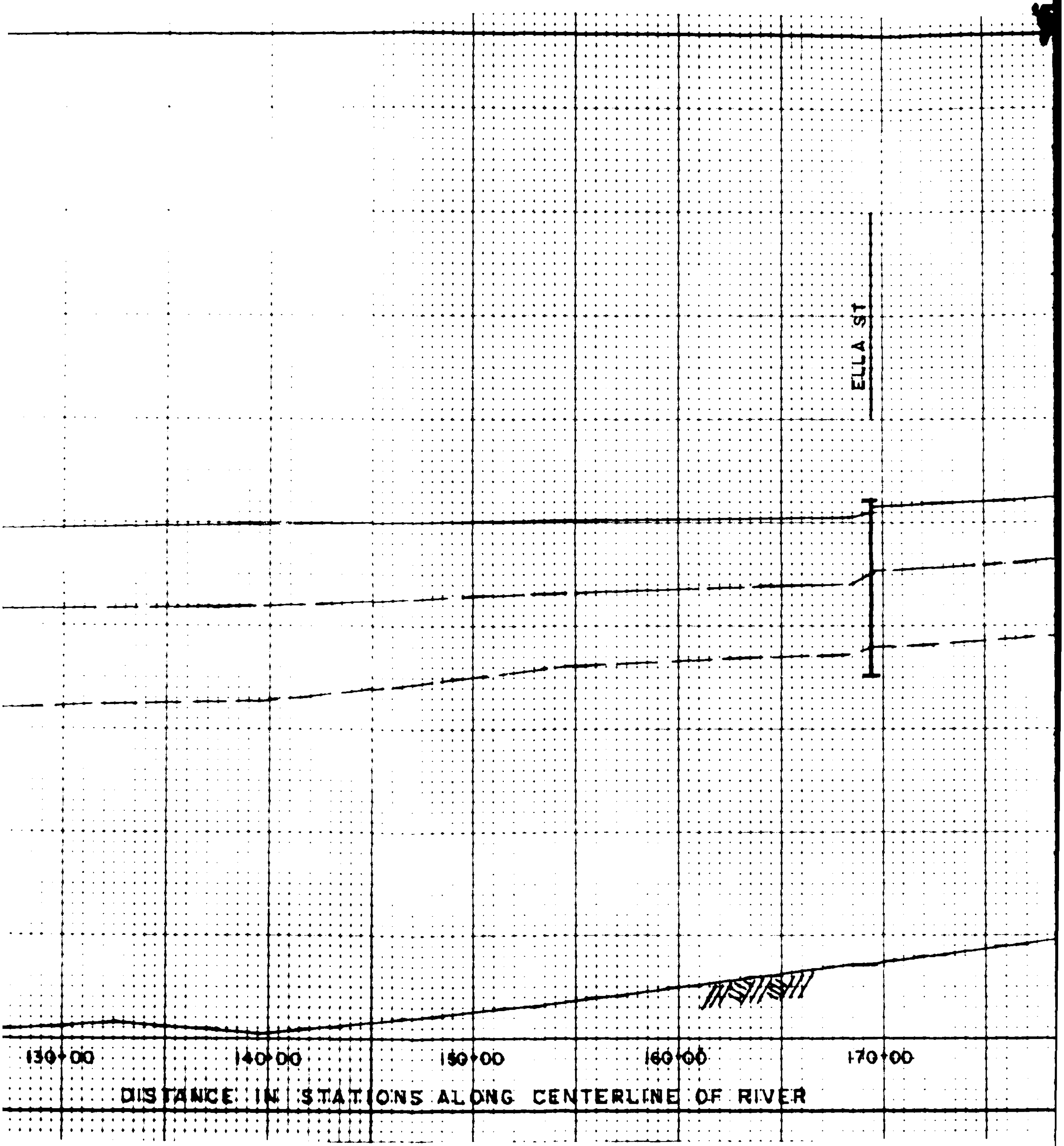
120+00
130+00



ELLA ST
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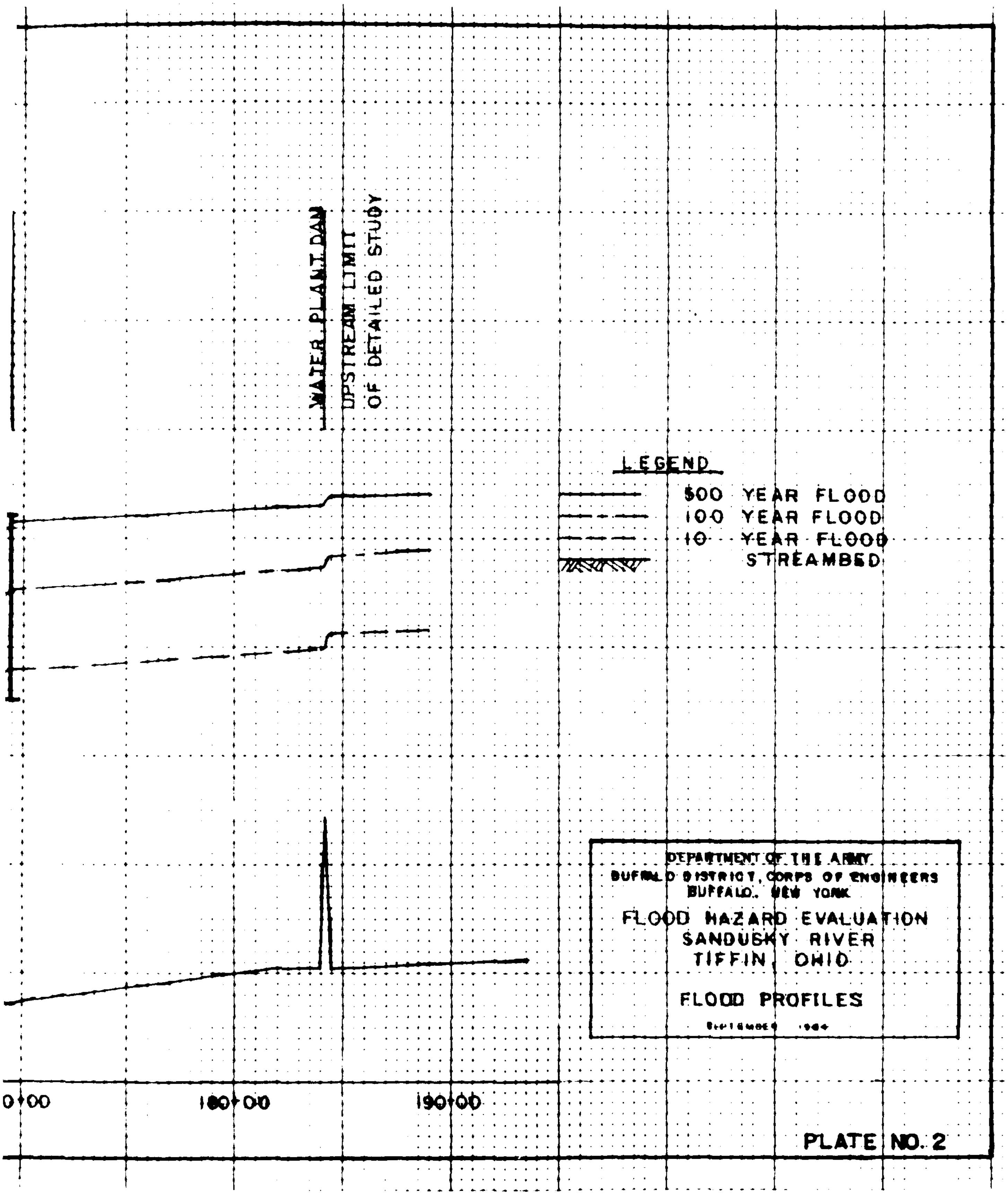
DISTANCE IN STATIONS ALONG CENTERLINE OF RIVER


WATER PLANT DAM
UPSTREAM LIMIT
OF DETAILED STUDY
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500 YEAR FLOOD
100 YEAR FLOOD
10 YEAR FLOOD
STREAMBED
DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
BUFFALO, NEW YORK
FLOOD HAZARD EVALUATION
SANDUSKY RIVER
TIFFIN, OHIO
FLOOD PROFILES
0+00
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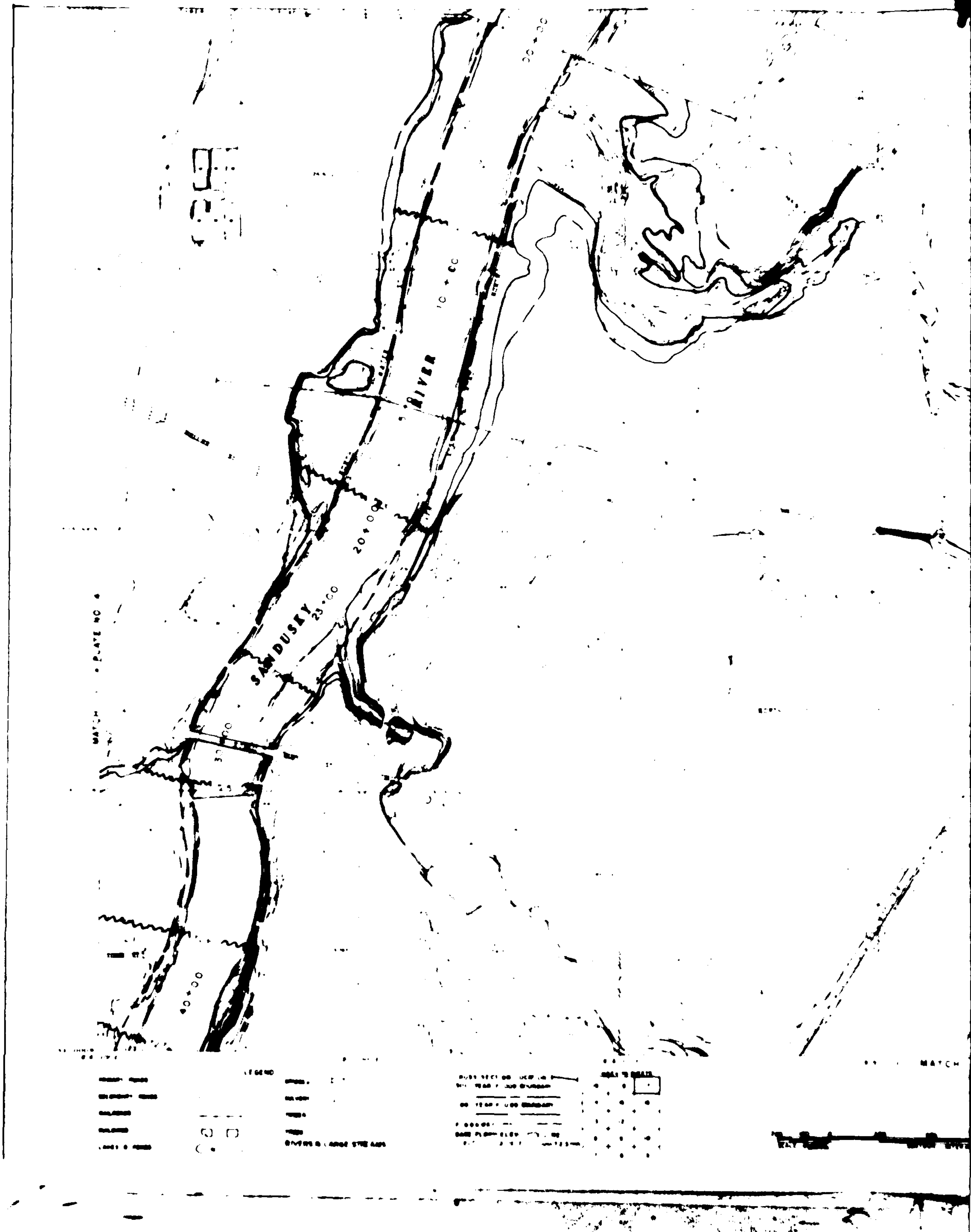
PLATE NO. 2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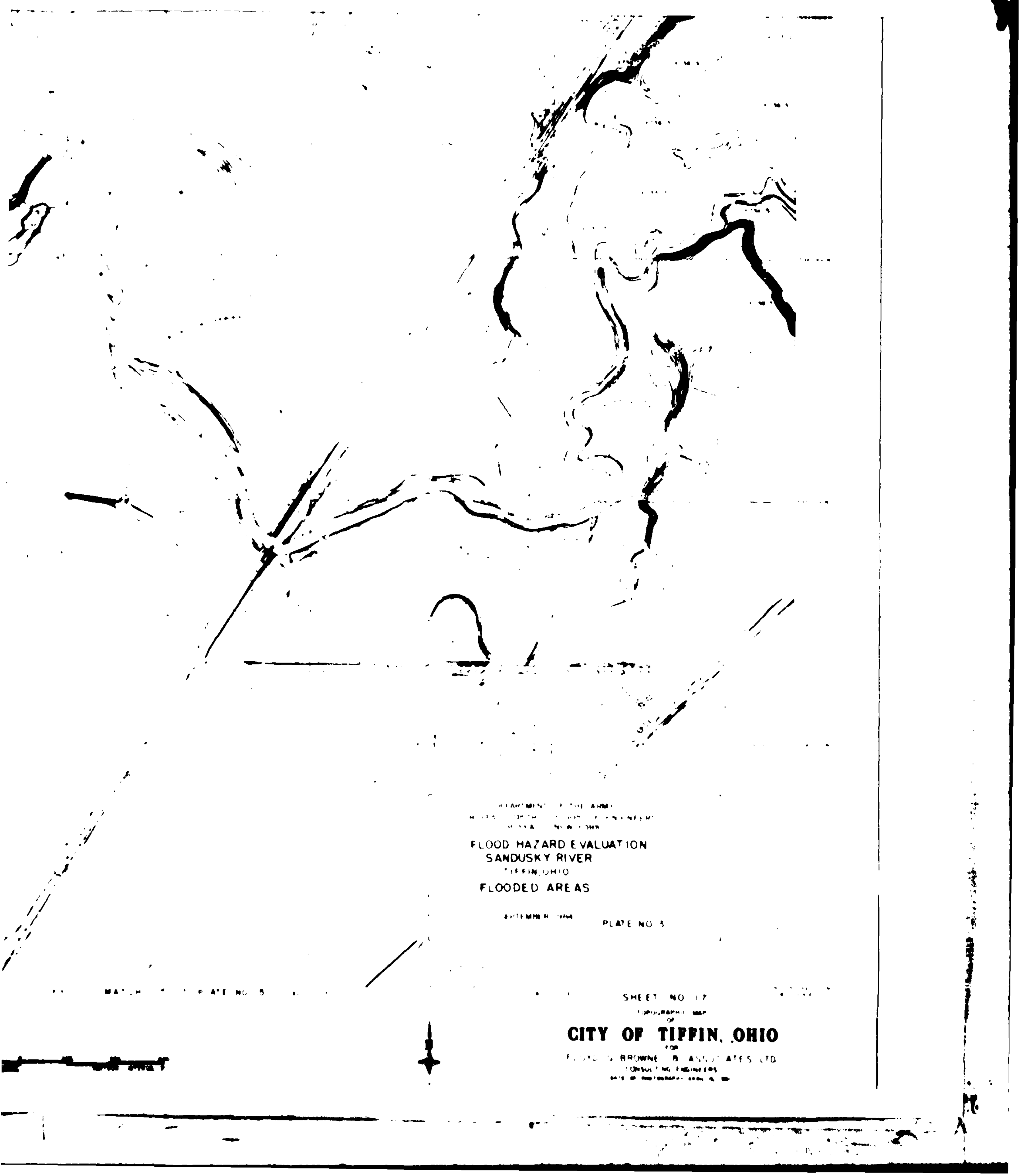
LEGEND
MATCH



FLOOD HAZARD EVALUATION
SANDUSKY RIVER
FLOODED AREAS
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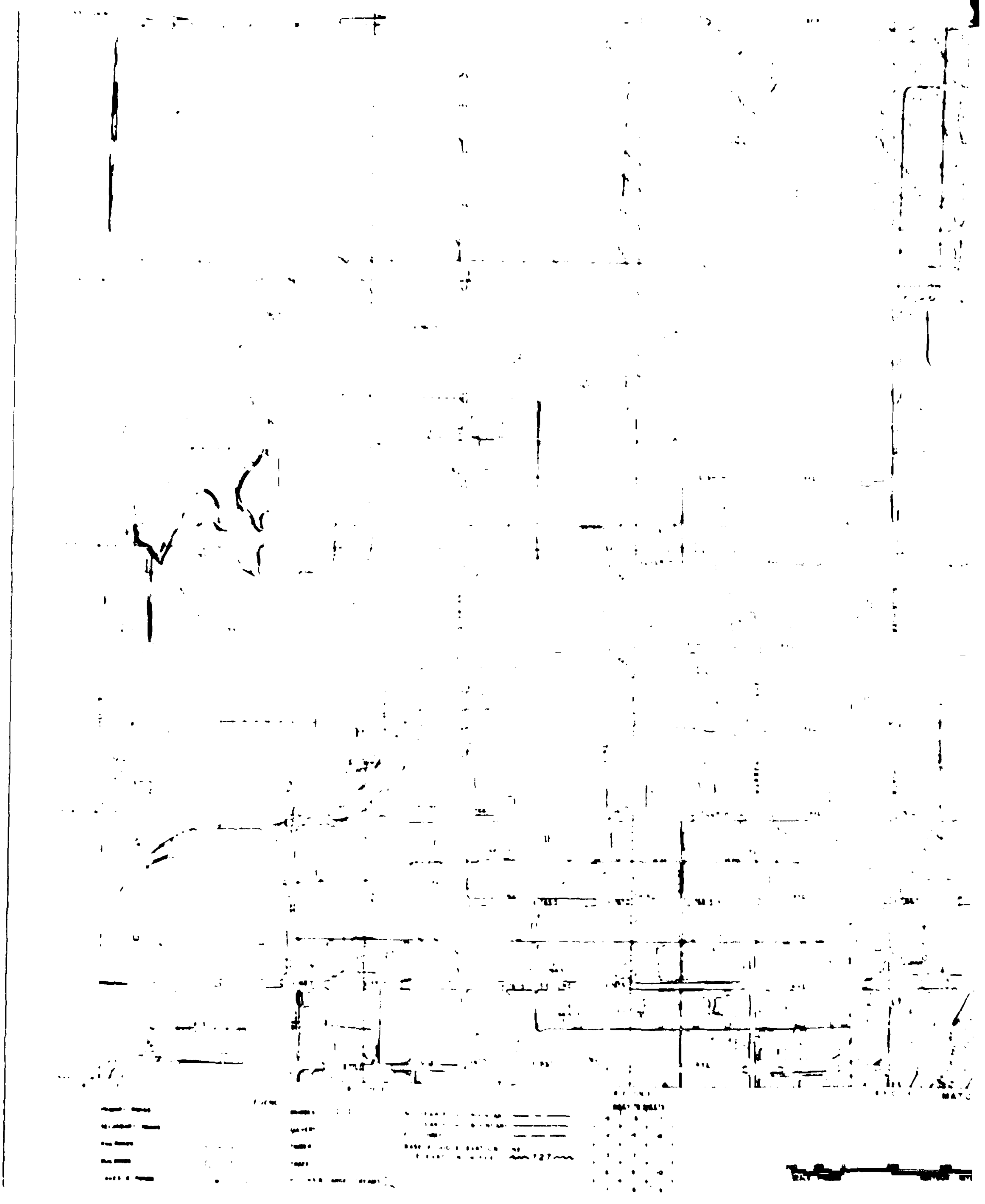
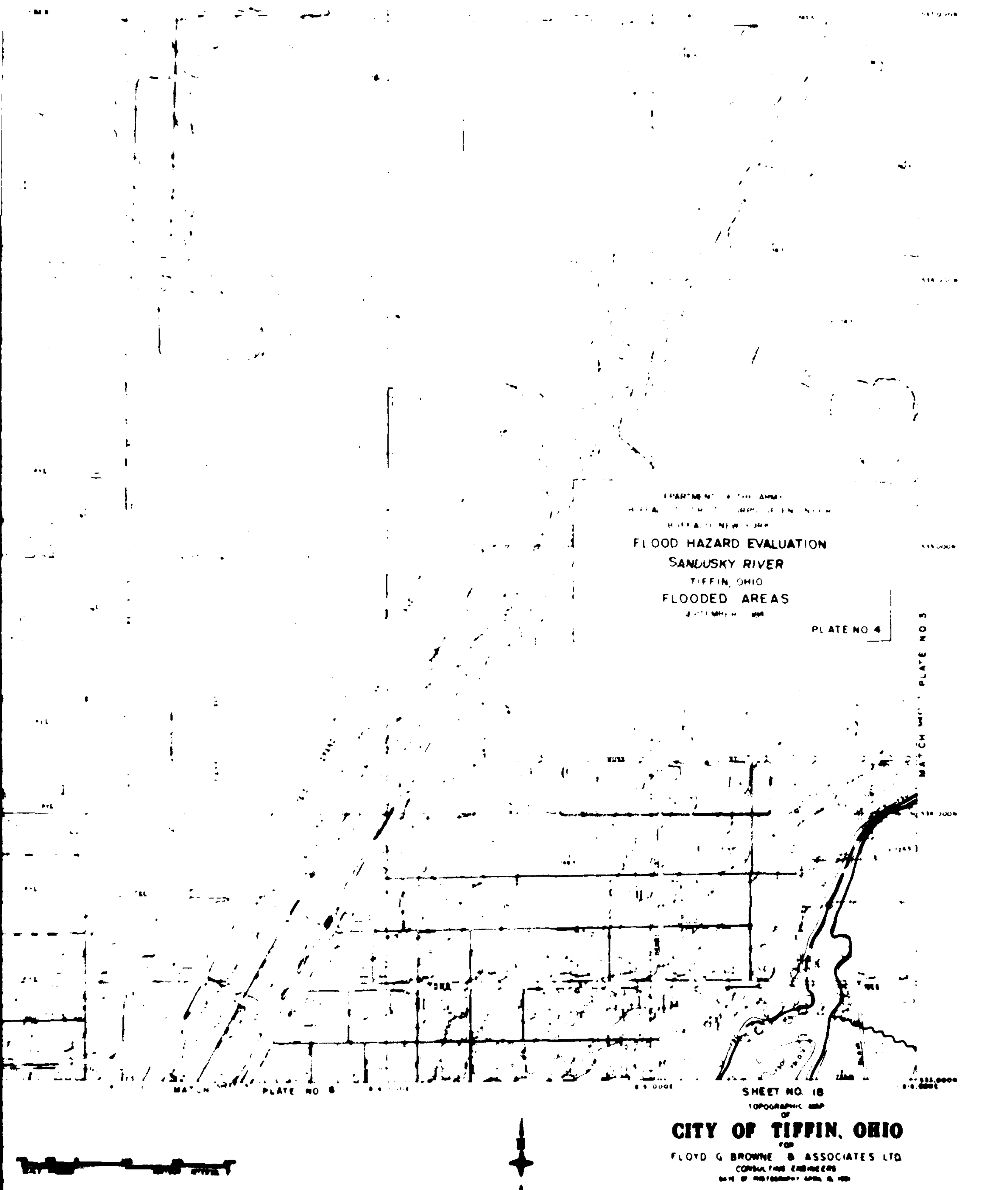
CITY OF TIFFIN, OHIO

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TIFFIN, OHIO
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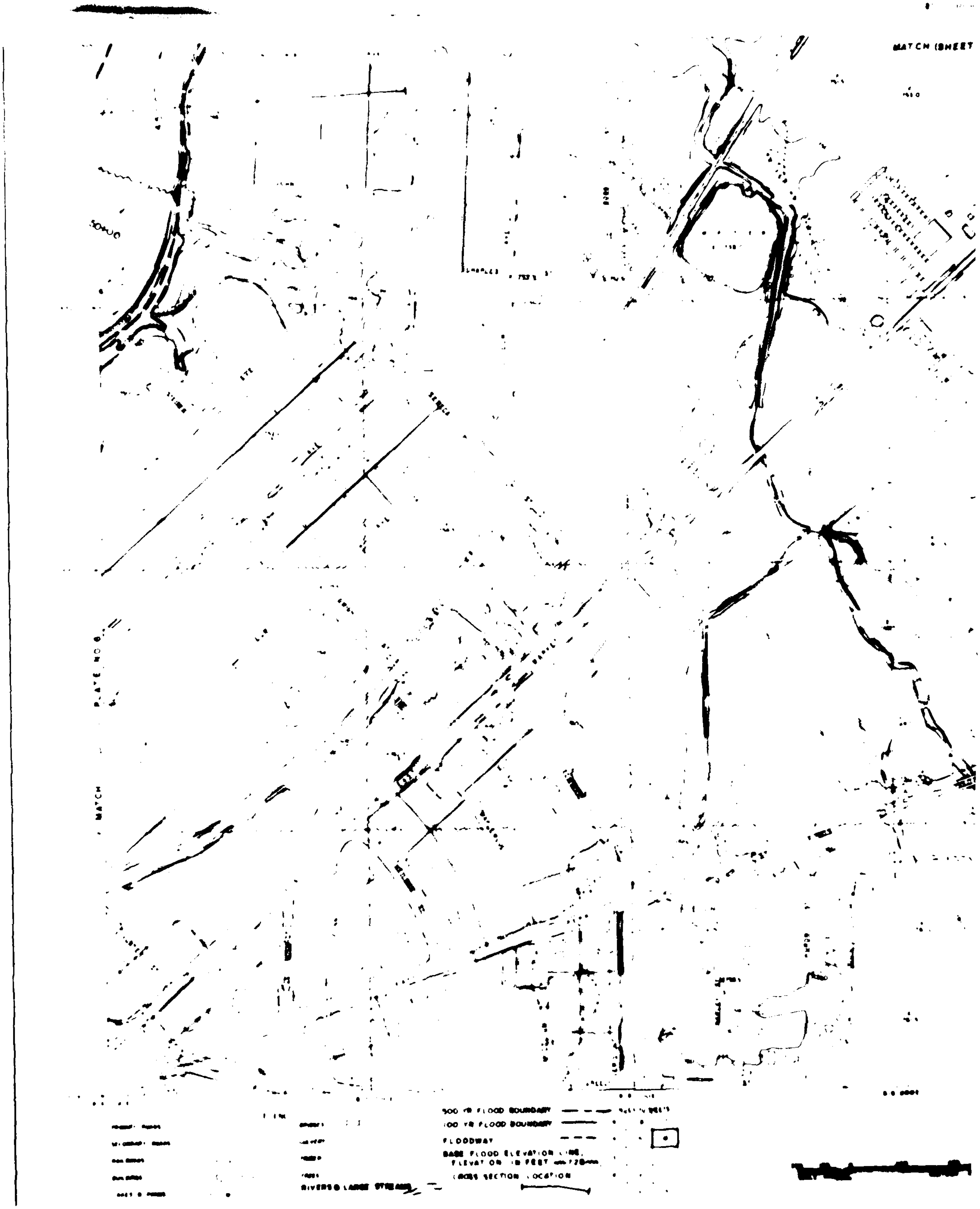
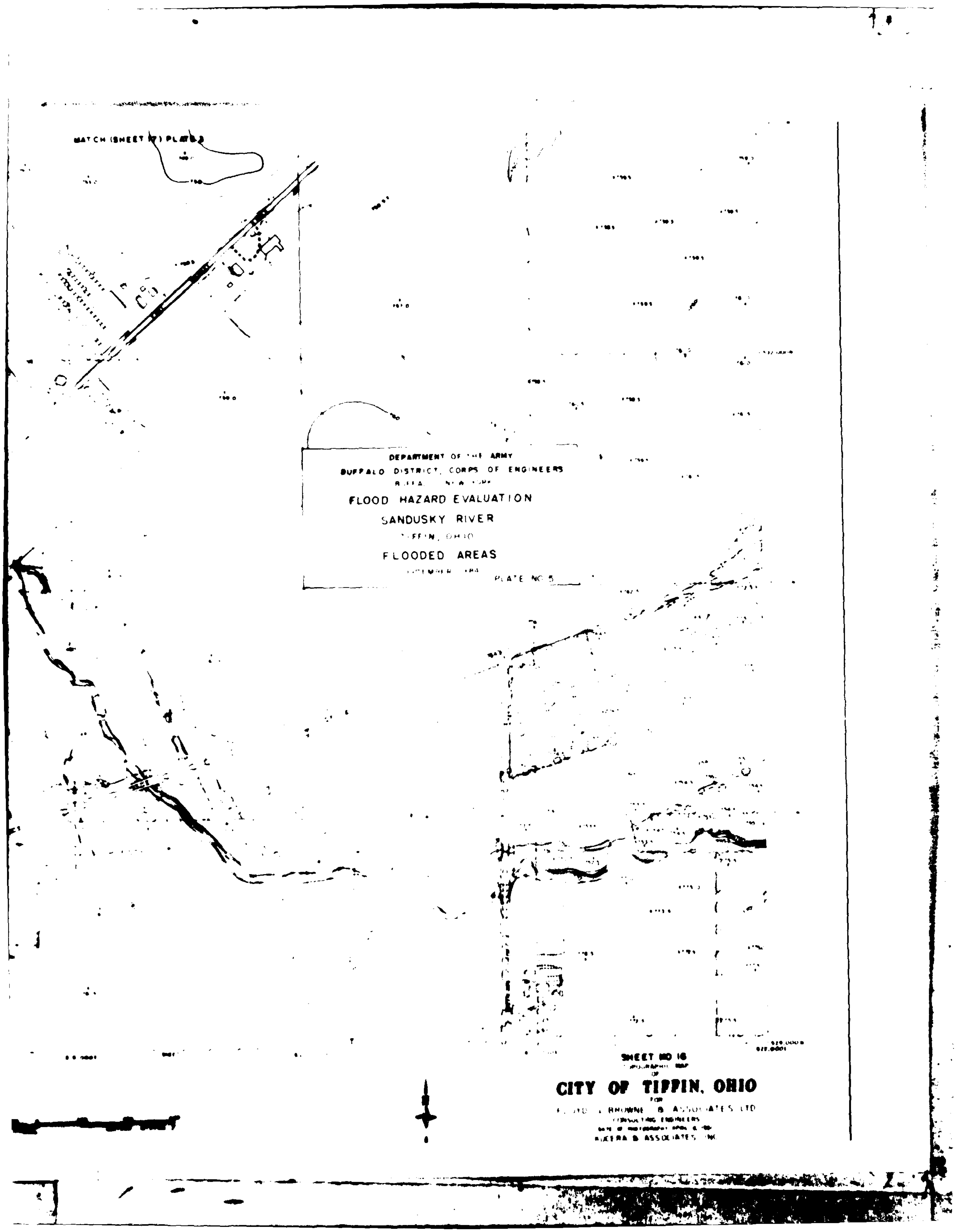
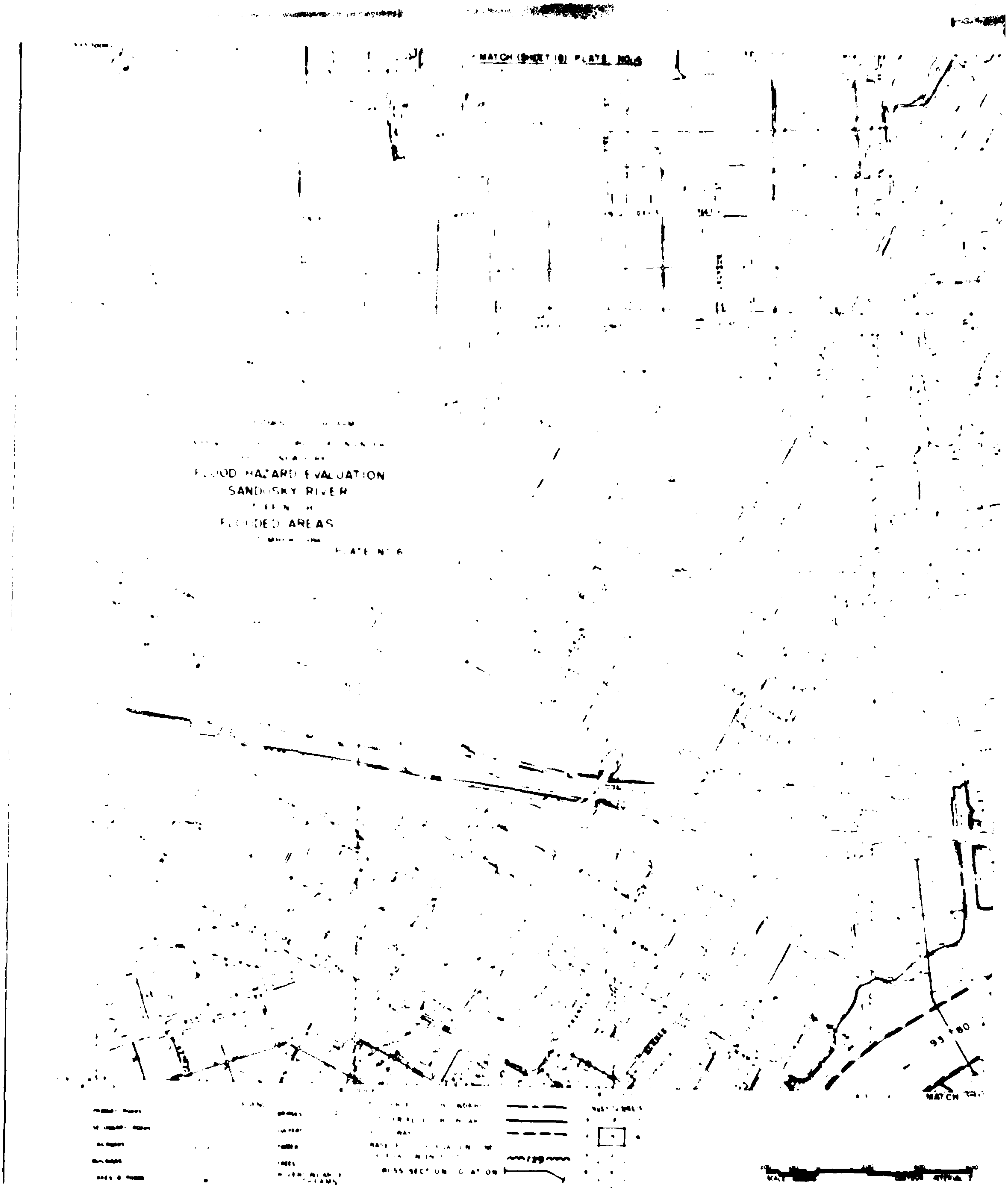
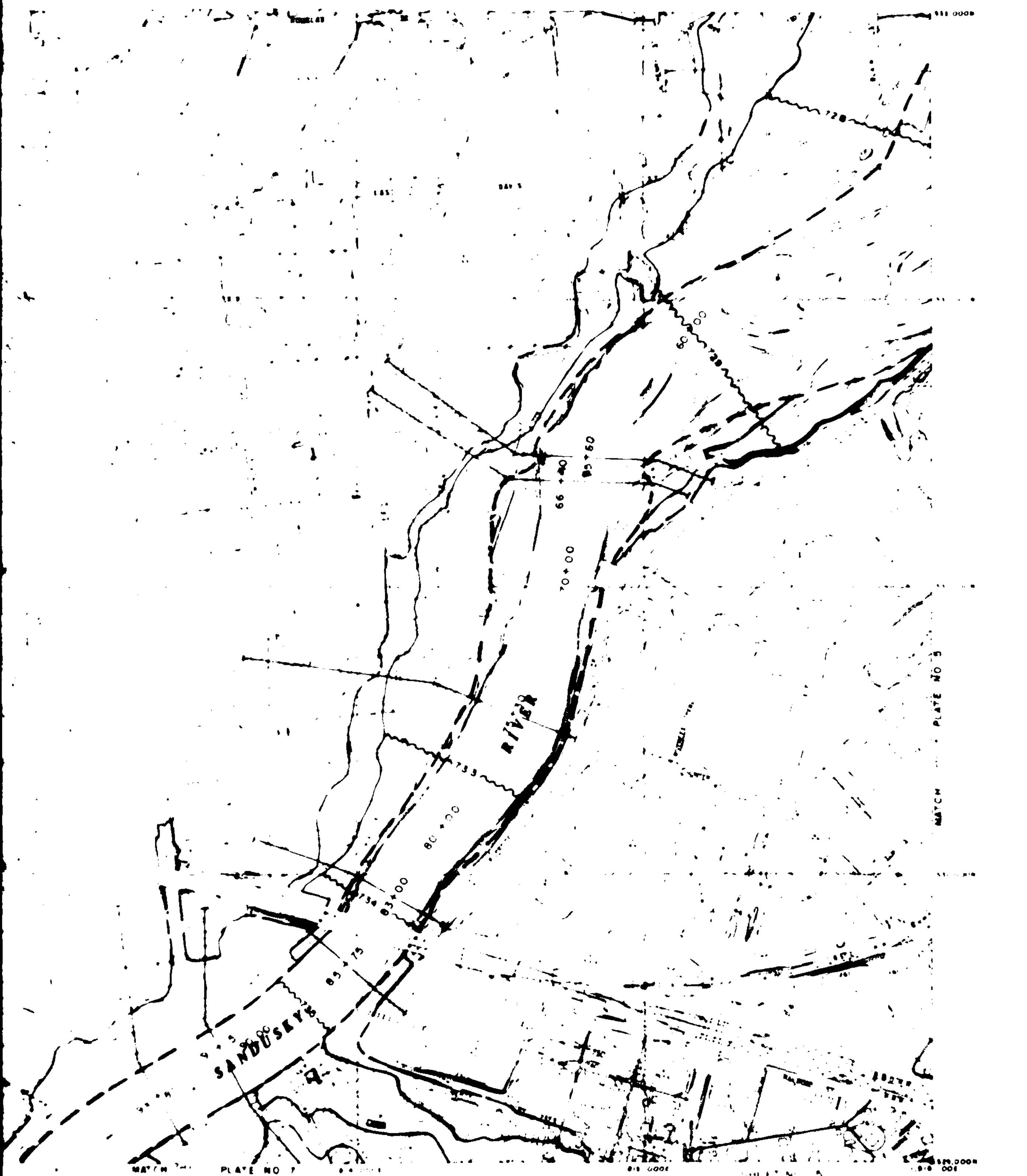
CITY OF TIFFIN, OHIO
FLOYD G BROWNE & ASSOCIATES LTD


MATCH SHEET
50+00
500 YR FLOOD BOUNDARY
100 YR FLOOD BOUNDARY
FLOODWAY
BASE FLOOD ELEVATION LINE,
ELEVATION IN FEET
CROSS SECTION LOCATION
RIVERS & LARGE STREAMS


MATCH (SHEET 17) PLATE 3
DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
FLOOD HAZARD EVALUATION
SANDUSKY RIVER
FLOODED AREAS
PLATE NO 5
SHEET NO 16
CITY OF TIFFIN, OHIO
CONSULTING ENGINEERS

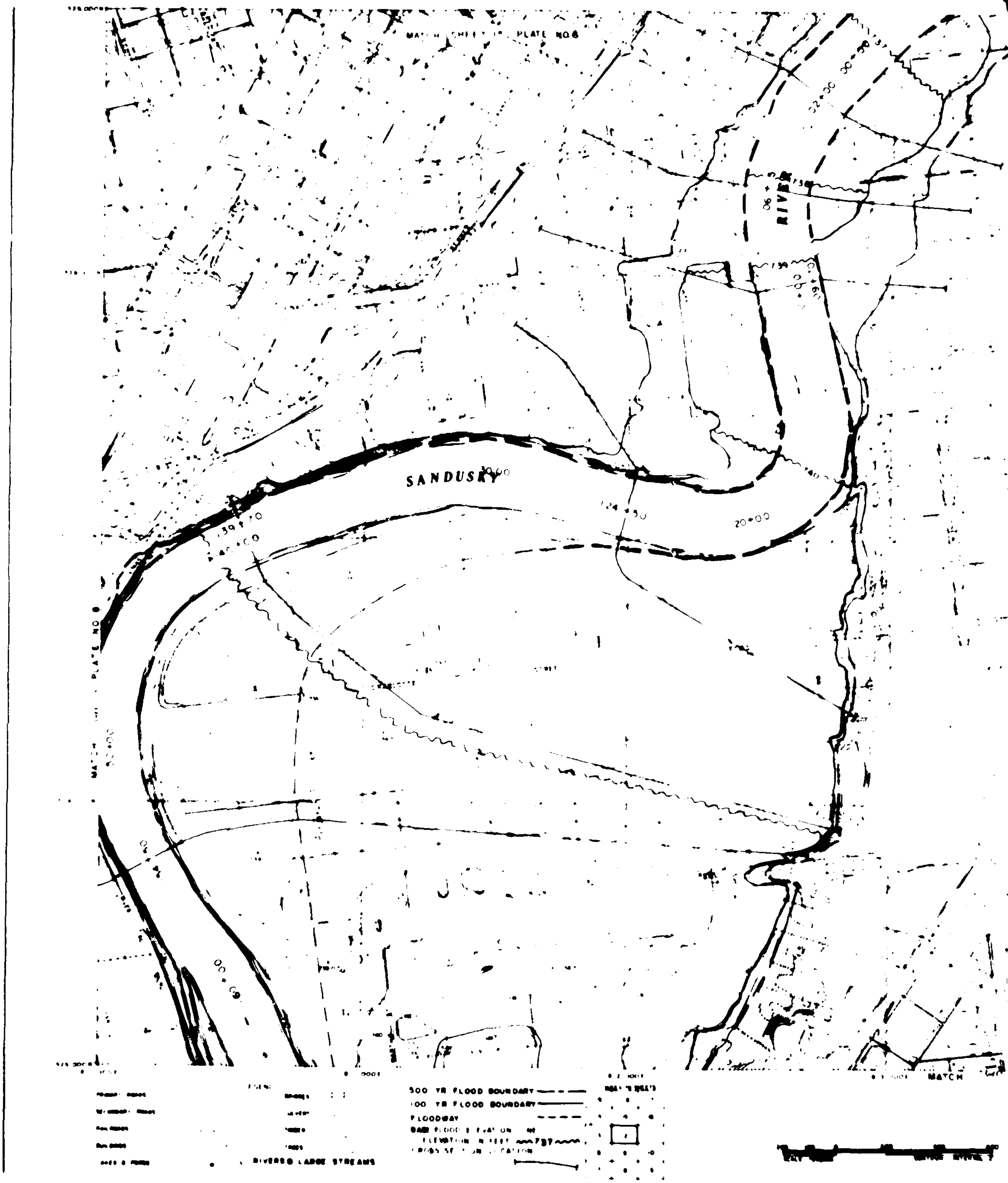

MATCH (SHEET 6) PLATE NO. 6
FLOOD HAZARD EVALUATION
SANDUSKY RIVER
FLOODED AREAS
PLATE NO. 6
93+80
CROSS SECTION LOCATION

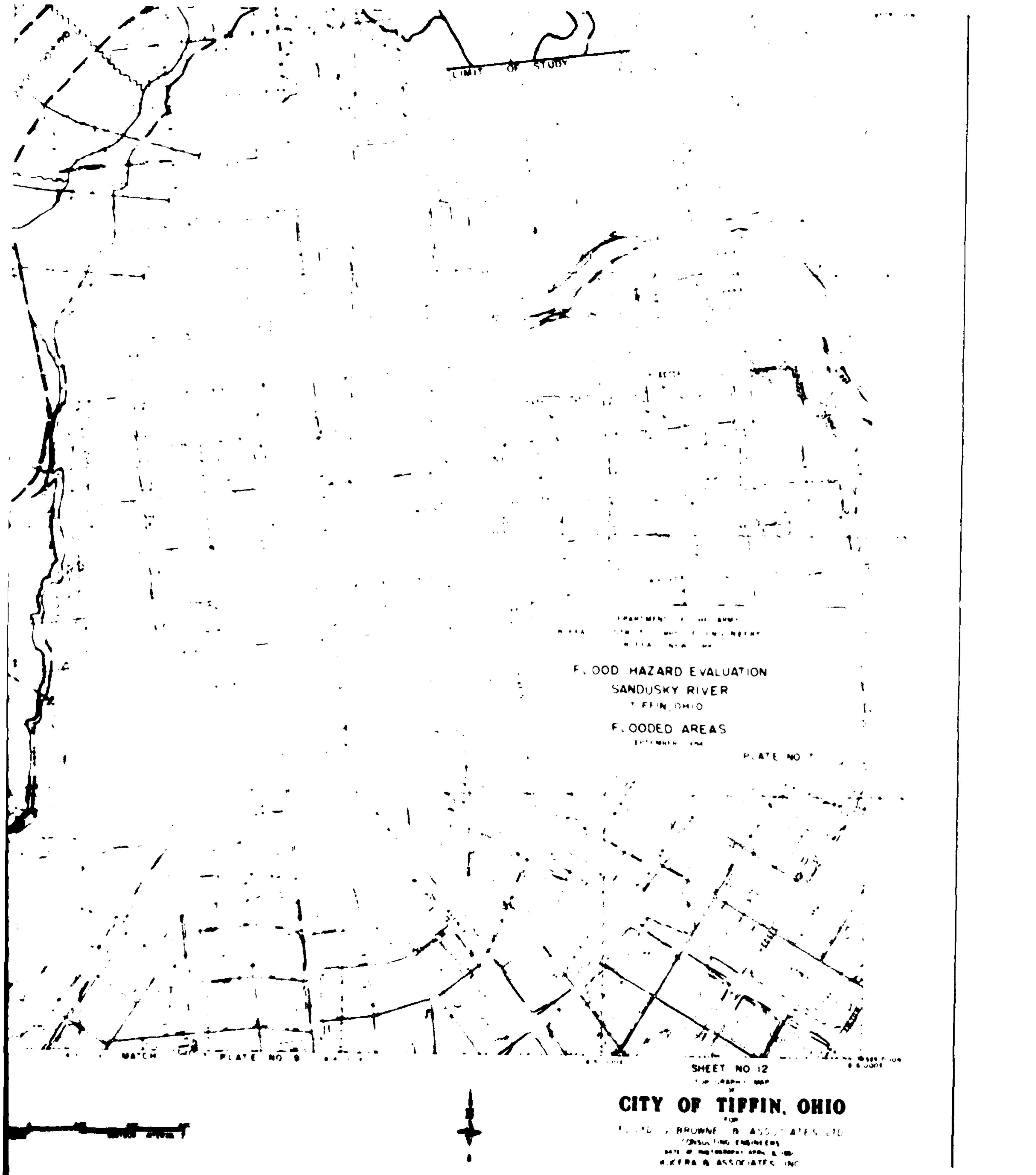


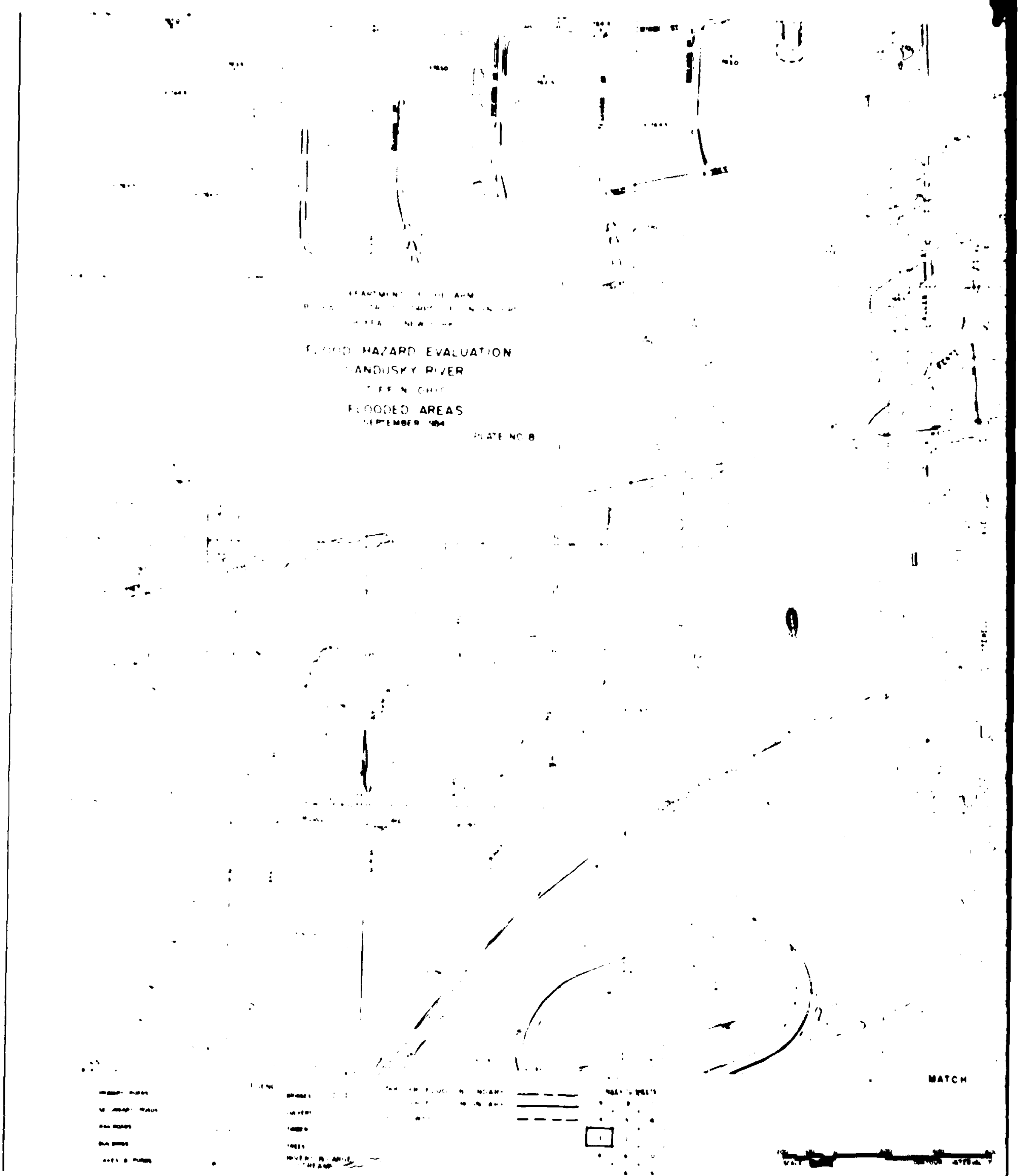
SHEET NO 5

TOPOGRAPHIC MAP
OF
CITY OF TIFFIN, OHIO
FOR
FLOYD G BROWNE & ASSOCIATES LTD
CONSULTING ENGINEERS

KUCERA & ASSOCIATES INC


SANDUSKY
RIVER
500 YR FLOOD BOUNDARY
100 YR FLOOD BOUNDARY
FLOODWAY
RIVERS & LARGE STREAMS
MATCH

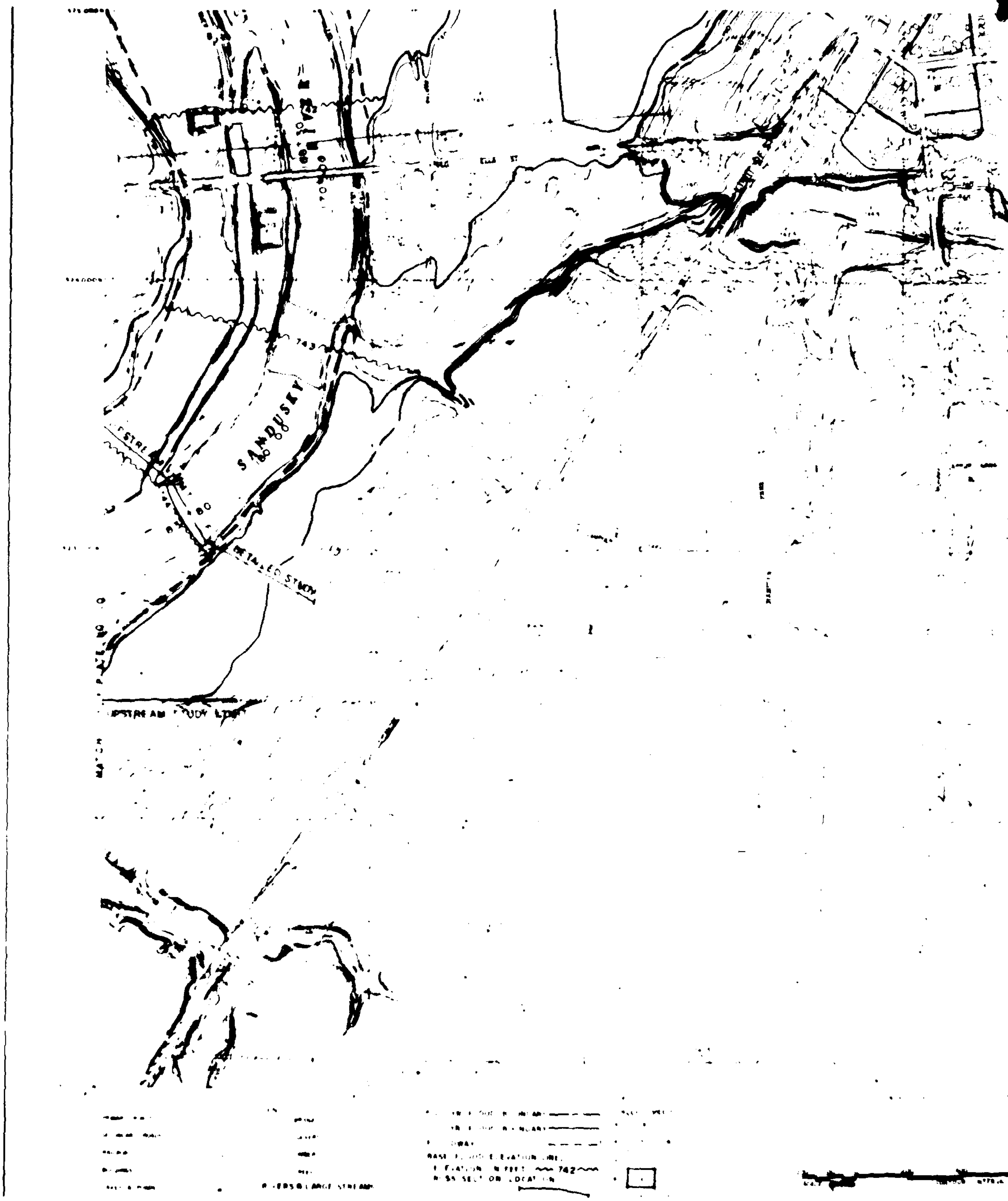

LIMIT OF STUDY
SANDUSKY RIVER
FLOODED AREAS
MATCH PLATE NO 8
SHEET NO 12
CITY OF TIFFIN, OHIO
BROWNE & ASSOCIATES
ASSOCIATES INC

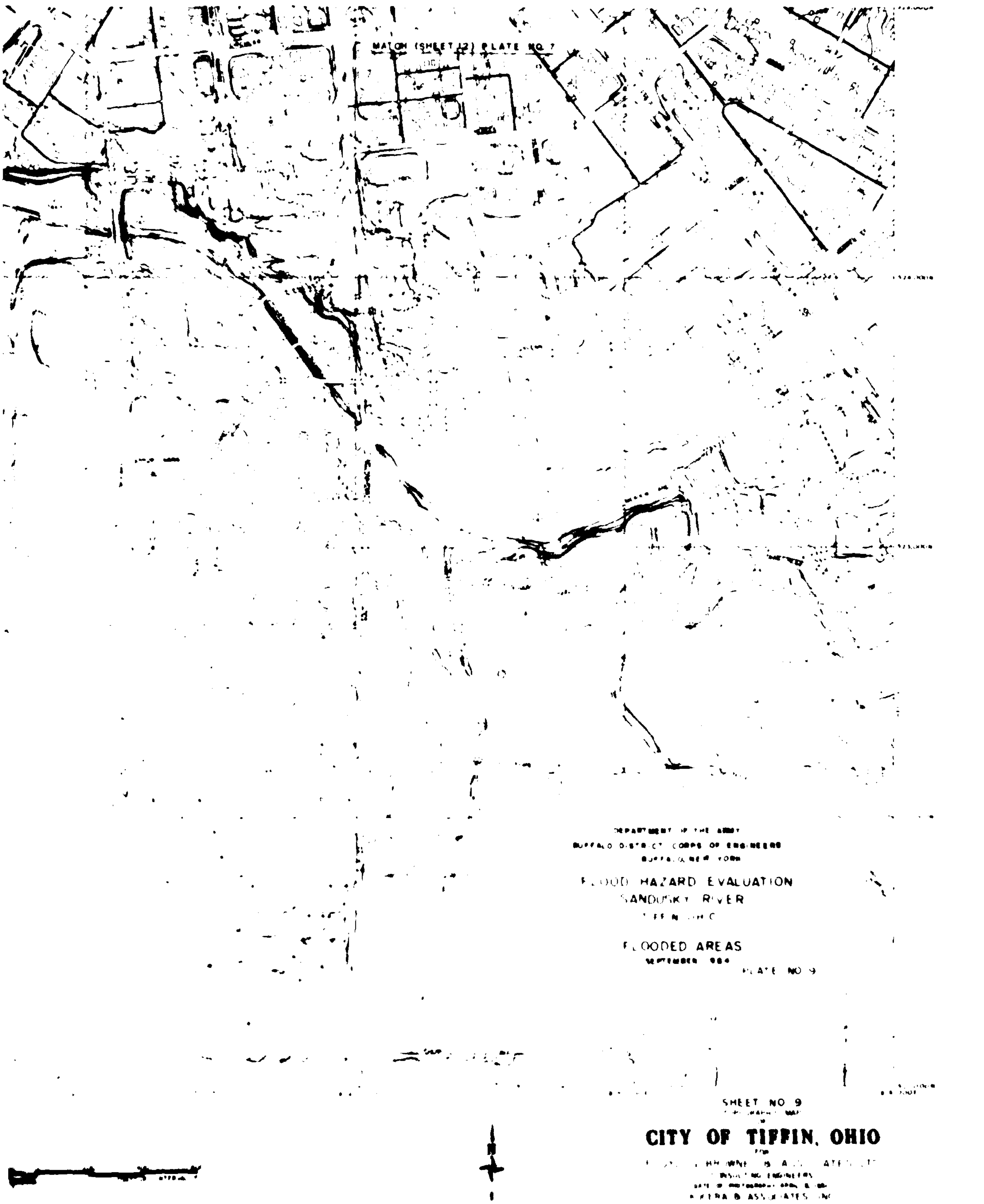


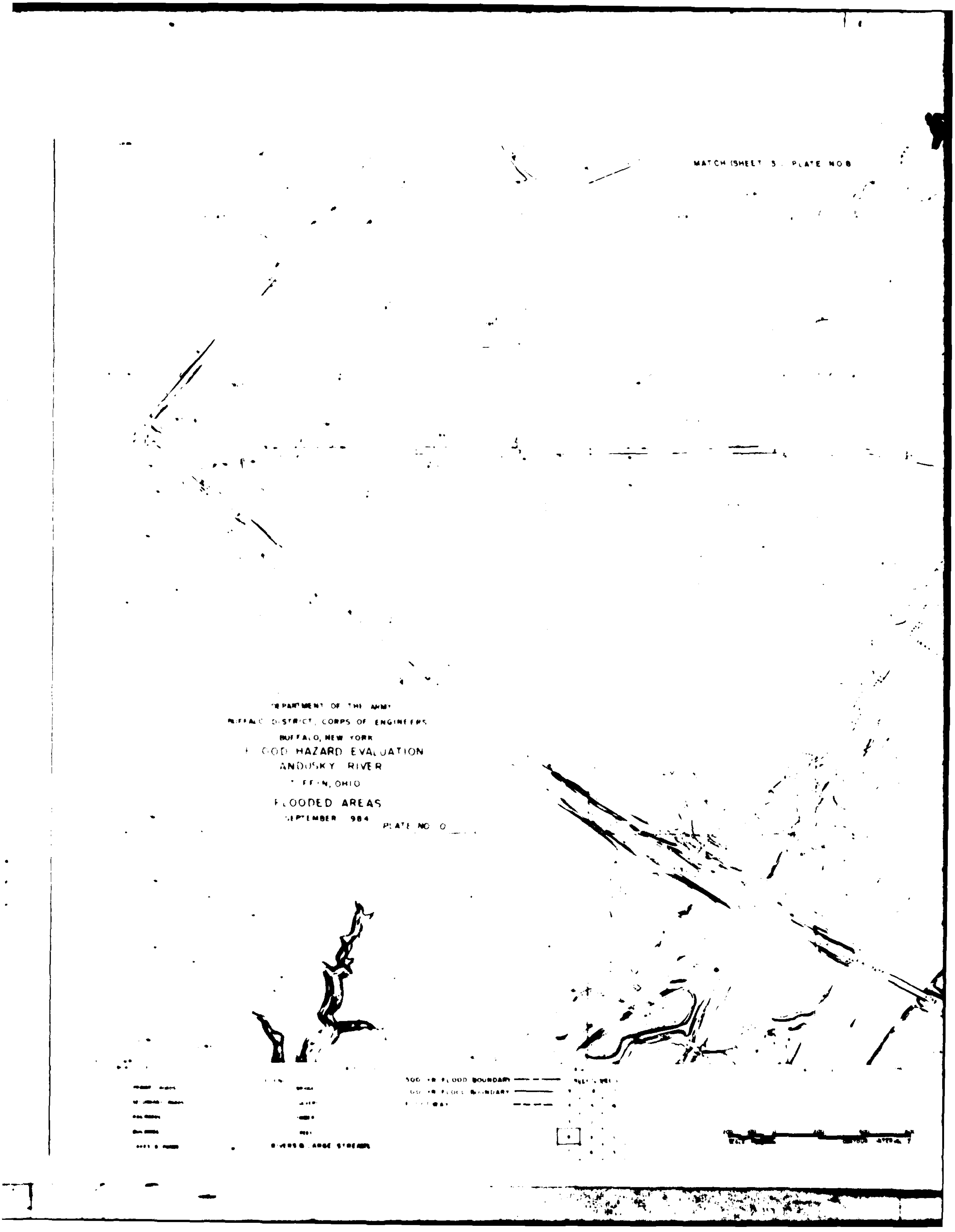
HAZARD EVALUATION
ANDUSKY RIVER
AREAS
PLATE NO. 8
MATCH

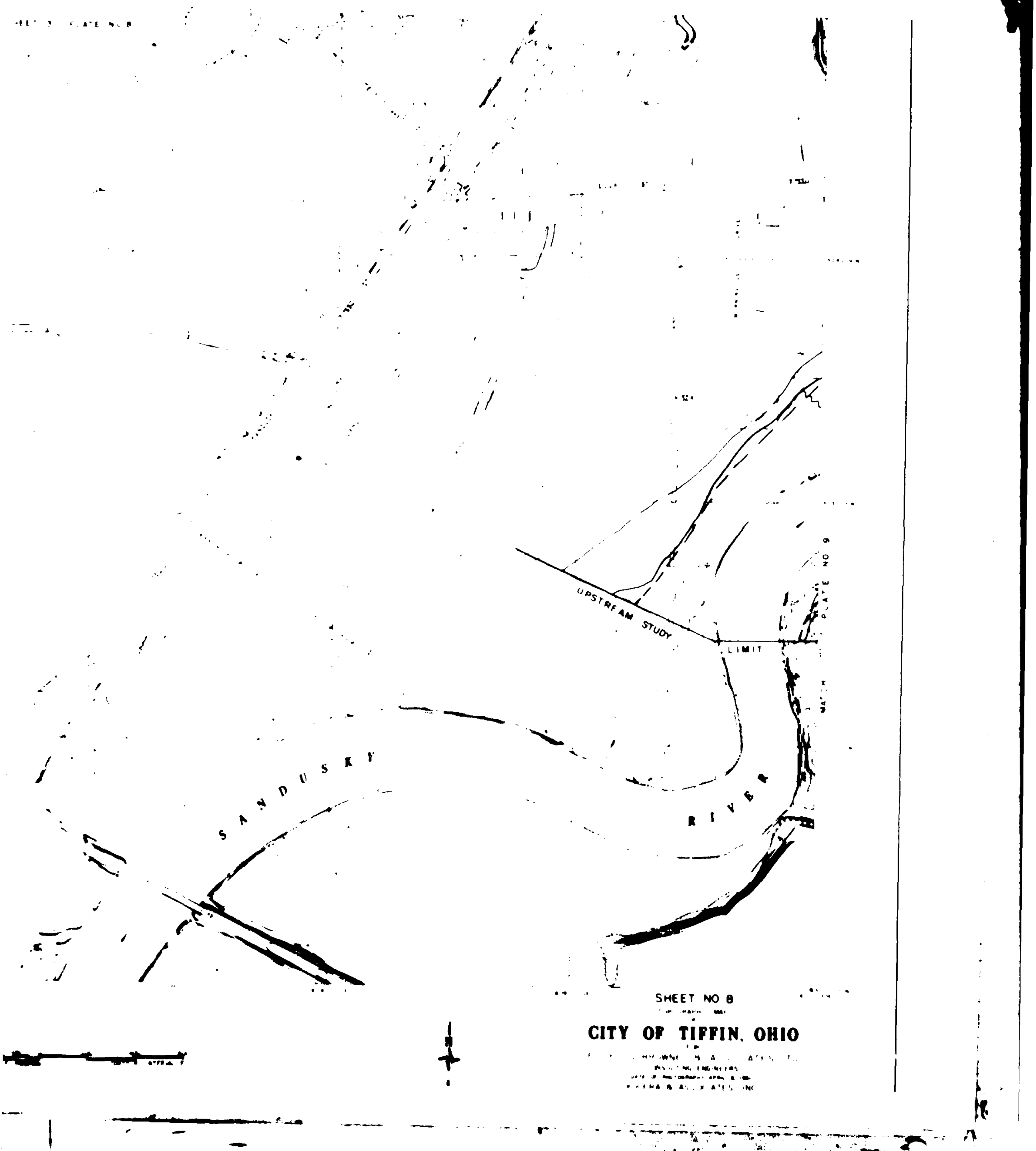
SHEET NO 13

CITY OF TIFFIN, OHIO


SANDUSKY
743
DETAILED STUDY
UPSTREAM STUDY LIMIT
BASE FLOOD ELEVATION LINE
ELEVATION IN FEET 742
RIVERS & LARGE STREAMS


MATCH (SHEET 12) PLATE NO 7
DEPARTMENT OF THE ARMY
BUFFALO DISTRICT CORPS OF ENGINEERS
BUFFALO, NEW YORK
FLOOD HAZARD EVALUATION
SANDUSKY RIVER
FLOODED AREAS
PLATE NO 9
SHEET NO 9
CITY OF TIFFIN, OHIO
CONSULTING ENGINEERS


MATCH SHEET 5, PLATE NO 8
DEPARTMENT OF THE ARMY
DISTRICT, CORPS OF ENGINEERS
BUFFALO, NEW YORK
HAZARD EVALUATION
RIVER
OHIO
AREAS
984
PLATE NO
500 YR FLOOD BOUNDARY
RIVERS & LARGE STREAMS


UPSTREAM STUDY
LIMIT
SANDUSKY
RIVER
MATCH PLATE NO 9
SHEET NO 8
CITY OF TIFFIN, OHIO

END

DATE
FILMED
2-85

DTIC